A C T A P A R A S I T O L O G I C A P O L O N I C A
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Helella rhizodrili gen. n., sp. n. (*Ciliata — Astomata*)

The ciliate to be investigated was found in the intestine of oligochaete *Rhizodrilus pilosus* Goodrich which occurs in sand and bottom slime in Puck Bay (Southern Baltic) just off the shore at a depth of 0.5 — 1 m. Material of the present author comes from the surroundings of Kuźnica in the Hel Penninsula.

Material was investigated on the spot and transported to Warszawa in alive *Oligochaeta*. In addition to infravital observations using contrast-phase and after photomicrographs of alive specimens were taken, there were used Ag. preparations after B. Klein, I. H. — stained preparations after Heidenhain, fixed in alcohol sublimate by Schaudinn's method.

Dimensions and shape of the body. *Helella rhizodrili* g.n., sp.n. is 90 — 200 μ long and 70 — 90 μ wide. The ovoid-shaped body is considerably flattened. This flattening can be defined as dorso-ventral and consequently one can single out two sides: dorsal and ventral, lateral margins: left and right, and posterior one (according to the Chatton et Lwoff 1946 convention). The right margin is always longer than the left one, hence the posterior margin runs more or less diagonally to the longitudinal axis of the body of ciliate (Fig. 1a). The body reaches its maximum thickness about one third of its length and then tapers.

On the anterior pole of the body, there is an apical pyramid-shaped elevation the base of which is an oxygonal triangle. The elevation is formed by the apical part of the cytoskeleton which lifts the pellicle. The elevation has two distinct margins clearly visible from the ventral side — the right margin being plainly longer than the left one. The left margin of the elevation passes into the left margin of the body, and the right margin is shifted from the right margin of the body towards its ventral side. This enhances the effect of an asymmetrical structure of the body of *Helella rhizodrili*. The flattening of the body (no matter what its genesis be), the concavity in the front part of the ventral surface, and the asymmetric nature are, to greater or lesser extent, like conditions in the genus *Metaradiophrya* (*Astomata*) or the family *Hysterocinetidae* (*Thigmotricha*).

Cytoskeleton

The cytoskeleton of *H. rhizodrili* g.n., sp.n. consists of numerous fibrils which are found on the ventral side of the anterior part of the body and at both its lateral margins. The number of skeletal fibrils ranges from 30 to 40. These fibrils converge at the anterior part making up the apical part of the cytoskeleton, i.e., the apical elevation of the body. Thus it seems that the apical part of the cytoskeleton consists of skeletal fibrils which converge

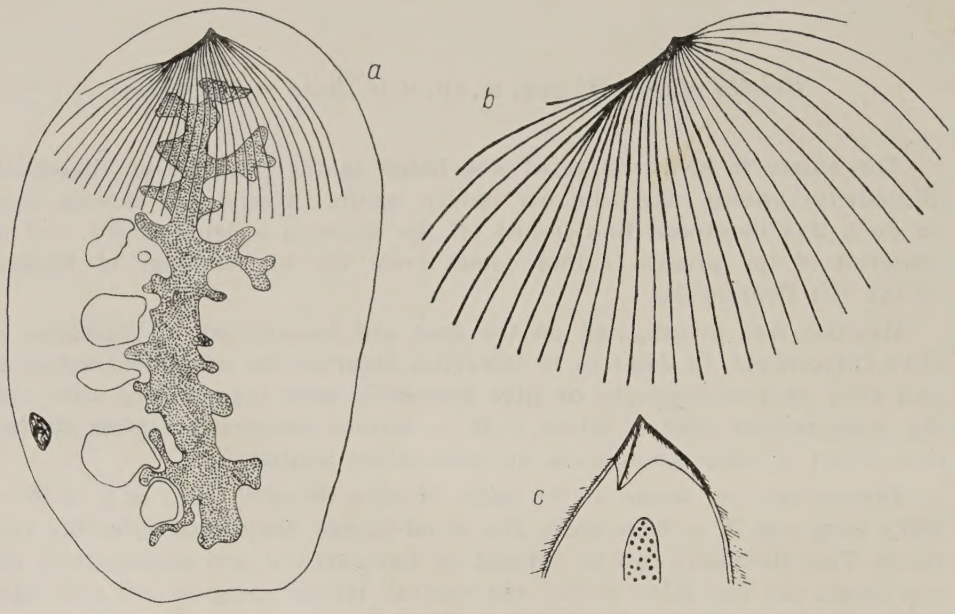

Fig. 1. a — *Helella rhizodrili*, total specimen; b — *H. rhizodrili*, cytoskeleton; c — *Durchoniella brasili* Leg. Dub., apical part af cytoskeleton, after Puytorac.

and join here, and the majority of which reaches the summit. Relationship in the structure of the cytoskeleton can be also interpreted in a somewhat different way, namely the cytoskeleton can be considered as an uniform formation, compact in its apical part and splitting towards the hind part into numerous fibrils. The occurrence of one or two fibrils, free at both ends and not joined to the others in anterior part, argues in favour of the first interpretation, according to which the concrescence of fibrils into one common apical formation gives basis to the cytoskeleton (Phot. 1).

In most *Astomata* which have the cytoskeleton consisting of skeletal fibrils convergent in the front part at the basis of the cytoskeleton, the structure of the latter seems to be an independent element distinct from the fibrils. These conditions are shown by the genus *Radiophrya*, *Metaradiophrya*, *Orchidanus* and *Durchoniella*. *Radiophrya*, for instance, have the cytoskeleton which is built on V-shaped base at the ventral side with fibrils radially going off.

On the other hand, in *Jiroveciella hegemonis* Lom 1957 there appears in the anterior part of the body skeletal fibrils free at both ends running parallel to the kineties under the surface of pellicle. Further, the arrangement of fibrils in *Desmophrya contorta* Raabe 1935 is of slightly different character. Fibrils run here at various depths in the plasm and converge at one point on the front pole of the body forming a punctuate connection yet not fusing into an apical proturberance.

Yet described in 1955 by Puytorac *Radiophrya intermedia* has a very similar body shape and cytoskeletal structure to the ciliate discussed above. I decided to create a new genus *Helella* including *H. intermedia* (Puytorac) and *H. rhizodrili* sp.n. The main differences are: catenular division and irregular arrangment of kineties on the margins of the body of *H. intermedia* and different shape of macronucleus (see down).

Nuclear apparatus

An elongated macronucleus lies approximately along the axis of the body and forms numerous and irregular shoots assuming the shape of the tree. The macronucleus shoots stretch out in different directions and planes deep into cytoplasm towards the surface of the body. Macronucleus occupies relatively

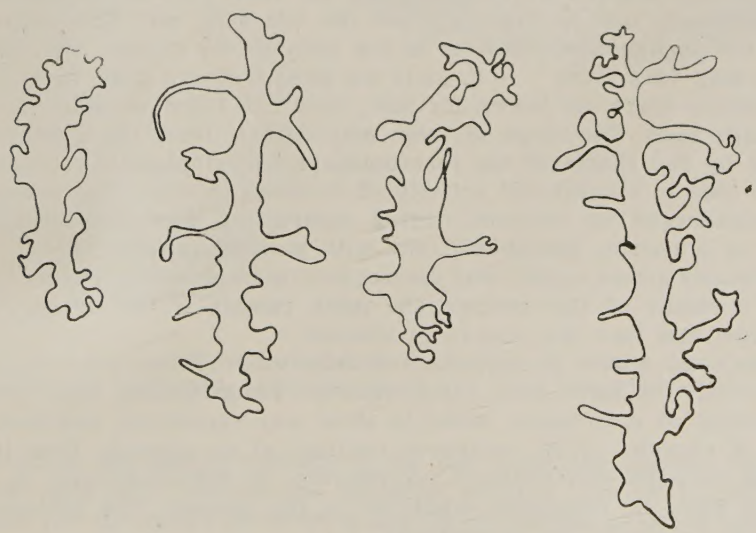

Fig. 2. Different shapes of the macronucleus of *Helella rhizodrili*

much space in the cytoplasm of the infusorian and shows a wide individual variability (Fig. 1, 2 and Phot. 1, 5 — 8).

From among *Astomata* the tree-shaped macronucleus has been already described. Cauliery et Mesnil 1907 described *Rhizocaryum concavum* which has a macronucleus of the shape similar to that referred to, and is

found in the intestines of *Polydora caeca* and *P. flava* (*Polychaeta*); Cunha et Fonseca 1918 found a similar species, *Anophophrya polydorae,* in the intestine of *Polydora socialis,* but the macronuclous of this ciliate was not ramified. Examining a ciliate from the intestine of *Polydora,* Puytorac failed to find forms with ramiried macronucleus and thus concluded the shape of the macronucleus described by Caullery et Mesnil to be artefacts resulting from fixation and consequently regarded *Rhizocaryum concavum* to be the synonim of *Anoplophyra polydorae.*

It is certain that the ramification of the macronucleus in *Helella rhizodrili* is not an artefact since in living specimens, just at the time they were extracted from the body of the host and kept long alive, I continually observed such a structure as well. Since the shape of nucleus as described above may be a natural phenomonon among *Astomata,* the Puytorac's conclusion does not hold entirely true or cannot be generalized at least. Also Lom observed a ramificated nucleus in *Maupasella vacuolata* in vivo.

Micronucleus of *H. rhizodrili* is lenticularly shaped and lies in the vicinity of the right margin of the body in its mid length or slightly shifted to the hind part.

Contractile vacuoles

Contractile vacuoles are ranged along the right side of the macronucleus and occasionally one or two occur on the left side, too. This arrangement sets off the asymmetric character of the body of the ciliate. The number of vacuoles may vary from 7 — 8, as is the most frequent case, to 11 or more, but sometimes there are fewer, for inst., two. The filled vacuoles reach relatively large sizes. The shape of them may deviate from the spherical being deformed by the shoots of the macronucleus or cytoplasmatic granulations.

I was able to observe the activity of vacuoles in vivo. The vacuole after having discharged its contents during contracting does not disappear but remains as a narrow amoeboidal slit with pointed projections.

The vacuole grows rapidly and assures ever more spherical shape. Occasionally, as a result of the contraction, there remain a few minor vacuoles which grow and fuse into one large vacuole.

Besides, two modes of reproduction referred to above are seen to occur simultaneously to form one, filled vacuole. Longstanding observations on large number of individuals failed to show any succession whatever in the activity of vacuoles which moreover contract at no constant time intervals. Thus, the vacuoles can contract successively, or simultaneously by two or three, but show no regularity whatever in this respect. The activity of the vacuoles is illustrated by photographs.

Ciliature

Ciliary system is formed by numerous, identical kineties running longitudinally from the base of the apical elevation to the hind margin of the body where the ends of the kineties are loose. The number of the kineties

ranges from 60 to 80. The kineties are most dense on the ventral side of the body in a deepening constituting a thigmotactic area analogically to the same area in *Metaradiophrya* or *Radiophrya* of *Astomata* or *Conchophthiridae* or *Hysterocinetidae* of *Thigmotricha*. The kineties radiating from the

Fig. 3. Ciliary system of *Helella rhizodrili*. a — General scheme of a dividing specimen; b — Frontal, unciliated field; c — Hind, unciliated field.

apical elevation run nearly parallel in the mid body and slightly converge again in its hind part towards the posterior margin. The nonciliated area which stands for the apical elevation is devoid of kineties as is the hind part occupying the posterior margin of the body (Fig. 3).

The kineties are joined by numerous transverse silver absorbing lines which, in turn, are joined by short longitudinal fibrils. The silver absorbing system has thus the shape of uniform network of fibrils on which there are longitudinally and regularly placed basal bodies covering the whole surface but the anterior and posterior non-ciliated areas. A similar pattern of silver absorbing system is characteristic of all *Hoplitophryidae* and *Anoplophyridae*.

Division

H. rhizodrili divides indistinctly obliquely. The division furrow runs slantly and bending in an arch-like manner to the fore is responsible for the difference in the length of the margins, the left margin of the primite to be longer than the right one (Fig. 3). Moreover, the primite is considerably larger than the opisthor. This inequality of the division may be undoubtedly related to the fact that the micronucleus before dividing moves in general to the rear, and that the parts of the macronucleus divided are unequal.

An oblique furrow separating the opisthor which is smaller than the primite appears in all *Hysterocinetidae* as well. The phylogenetically ventral margin corresponding to the *Helella* left margin is here always longer than the dorsal margin of the body corresponding to the *Helella* right margin. It thus seems that this type of division is connected with the similar for these groups general shape of body. The flattening and the elongation of the body of the ciliate can be clearly connected with separation of the opishor smaller than the primite, while the asymmetry induces the oblique character of the furrow.

It seems that such an unequal division is but a stage on the way to catenulation, like that taking place in the genus *Radiophrya* and occasionally in some *Hysterocinetidae*, i.e., in *Elliptothigma limnodrili* Meier according to Puytorac 1959.

The catenulation is connected not only with the elongation of the body but also, and may be chiefly, with the elongation of its macronucleus as well with the fact that the micronucleus is situated close to one of the margins of the body. Such a position of the micronucleus enables it to move towards the hind part of the body in the pre-divisional period. This causes the filial individuals to be unequal. This unequality and the formation of new division furrow at high rate due to the rapid growth of the protozoan leads to the catenular division.

The comparison of the catenulating species with *Helella rhizodrili* and the mode of their dividing provides some reasons for considering the division of the species examined as evolving towards the catenulation.

May be on the other hand that catenulating *H. intermedia* is more closely related to the family *Hysterocinetide* because of it irregular arrangment of kineties characteristic of many species of *Radiophrya* and of family *Hysterocinetidae*. It is also possible that lack of catenulation in *H. rhizodrili* is secondary and could be connected with the different shape of macronucleus. That last suggestion is correct if the hypothesis that astomatismus in *Radiophrya* is a secondary result of catenular division, what was put forward in my paper on *Protoptychostomum simplex* (in press), is right.

Conjugation

Conjugation of *Helella rhizodrili* runs as follow: one of the conjugants attaches itself by its thigmotactic surface to the right margin of the other in the vicinity of the anterior pole of the latter. One of the conjugants

lies on one side with its left margin up while the other lies on its ventral margin. I noticed no difference in the size of the conjugants.

The conjugation of *Ptychostomum saenuridis* Stein takes place, according to Heidenreich 1936, in a similar way. In this species one of the conjugants adheres with its sucker disposed in the front to the margin of the other and thus no touching of peristomes occurs.

Scarcity of the material as regards the conjugation of *Astomata* makes comparative considerations within this group impossible.

Systematic relations

As it was shown above *H. rhizodrili* shows many common characteristics with the family *Hysterocinetidae*. Beside the astomatismus main differences concern chiefly appearence of cytoskeleton in *Helella*. According to suggestion of Puytorac 1955 *H. rhizodrili* is conected by *H. intermedia* with insignificantly assymetrical *Radiophrya olivieri*. On the other hand in the paper on *Protoptychostomum simplex* (in press). I have pointed out the possibility of relations between *R. olivieri* and *Hysterocinetidae*. That colud explain the interrelations described above.

Helella rhizodrili sp. n. resembles in numerous characters the species of the genus *Radiophrya*. These are flattening and elongation of the body, a considerable number of contractile vacuoles arranged in longitudinal rows, similar conditions in the nuclear apparatus and anteriorly situated deepening in the front part of the ventral part of the body acting as a thigmoctatic area, strengthened by skeletal fibrils. It is probable that these similarities are convergent while the essential differences in the symmetry of the body can by no means be ignored (*Radiophrya* have bilateral symmetry).

The evidence to phylogenetic relationship can be, however, provided by similarities as between *Helella rhizodrili* and the genus *Durchoniella* Puytorac, e.g. *Durchoniella brasili* (Léger et Duboscq 1894). Both these genera exhibit a characteristic apical elevation in front of the body. In *Helella* this is the apical part of the cytoskeleton, covered with pellicle while in *Durchoniella* it is a naked weli developed apical part of the cytoskeleton laying on the surface of the body assuming the shape of a strong spike (Fig. 1c). From this spike there deviate numerous skeletal fibrils. This formation in *Durchoniella* may be supposed to develop from the apical part of the cytoskeleton which primarily was the same as in *Helella*, i.e. consisted of particular fibrils which converged here and were hidden under the pellicle.

Such a conclusion can be warranted by well known and sufficiently well grounded instances of the revolution of the cytoskeleton within the subfamily *Radiophryinae* (suffice to mention *Radiophrya* and *Ochridanus*) which provides good analogy to the case under discussion. *Ochridanus* have a V-shaped skeleton, much more prominent than in *Radiophrya*. This element lies on the surface of the body, not subpellicularly, and involves two firm hooks placed symmetrically (Puytorac 1959). The genus *Antonyella* has also developed a like cytoskeleton, the diference being in a single adhesive hook situated topmost of the characteristic V-shaped, basic element.

The ciliary system of *Durchoniella* consists of longitudinal kineties which run parallel from the base of the apical hook to the hind margin of the body (this arrangement resembles the pattern of the ciliary system in *Helella*). As compared with *Helella rhizodrili*, the species of the genus *Durchoniella* have a cylindrically shaped body and their adhesive apparatus is almost symmetrical. An insignificant asymmetry, like that found in *Helella*, is however seen (Puytorac 1954) in *Durchoniella* brasili (Léger et Duboscq) especially in the skeleton. Besides, these structural distinctions, particularly a better symmetry in *Durchoniella*, account for division of *Durchoniella* being typically transversal and not oblique as with *Helella*.

In spite of all the differences mentioned above, a number of similar characteristics among *Durchoniella* and *Helella* suggests distinct phylogenetic relationship between these ciliates.

Definitions

Genus *Helella* genus novum.

Ciliate of the family *Hoplitophryidae* (*Astomata*). Body flattened dorso-ventrally, slightly elongated, the asymmetry expressed by the right margin being longer than the left one. The deepening in the anterior part of the ventral side forms the thigmotactic surface. Cytoskeleton consists of fibrils which run in the anterior part of the ventral side and converge into the apical part; the latter bears the pellicle at the top of the body, thus forming a distinct apical elevation. Cytoskeletal fibrils run parallel to kineties under the surface of the pellicle. Ciliature consists of longitudinal, parallel kineties which run from the base of the apical elevation to the hind margin. Macronucleus elongated; micronucleus close to the right margin of Ma.

Type species: *Helella rhizodrili* g.n., sp.n.

Helella rhizodrili g.n., sp.n. *Helella* measuring 90 — 200 μ × 70 — 90 μ, number of kineties 60 — 80; number of cytoskeletal fibrils 30 — 40; Macronucleus has numerous lateral shoots.

Host: *Rhizodrilus pilosus* — Puck Bay, Southern Baltic Sea.

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STRESZCZENIE

Autor opisuje nowy rodzaj wymoczka, *Helella* gen. n. z rodziny *Hoplitophryidae* (*Astomata*), oraz nowy gatunek, *H. rhizodrili* sp. n. z jelita skąposzczeta *Rhizodrilus pilosus* Goodrich. Omówiony jest szczegółowo układ rzęskowy, cytoszkielet i aparat jądrowy tego pasożyta. Zwierzę jest spłaszczone grzbieto-brzusznie, ma na przodzie ciała po stronie brzusznej wklęsłą powierzchnię thigmotaktyczną, która jest wzmocniona fibryllami cytoszkieletu. Na podstawie porównań ogólnej morfologii ciała, budowy cytoszkieletu i ciliatury autor przypuszcza, że *Helella* gen. n. spokrewniona jest z jednej strony z *Radiophrya* a z drugiej z *Durchoniella*.

EXPLANATION OF PLATES I AND II

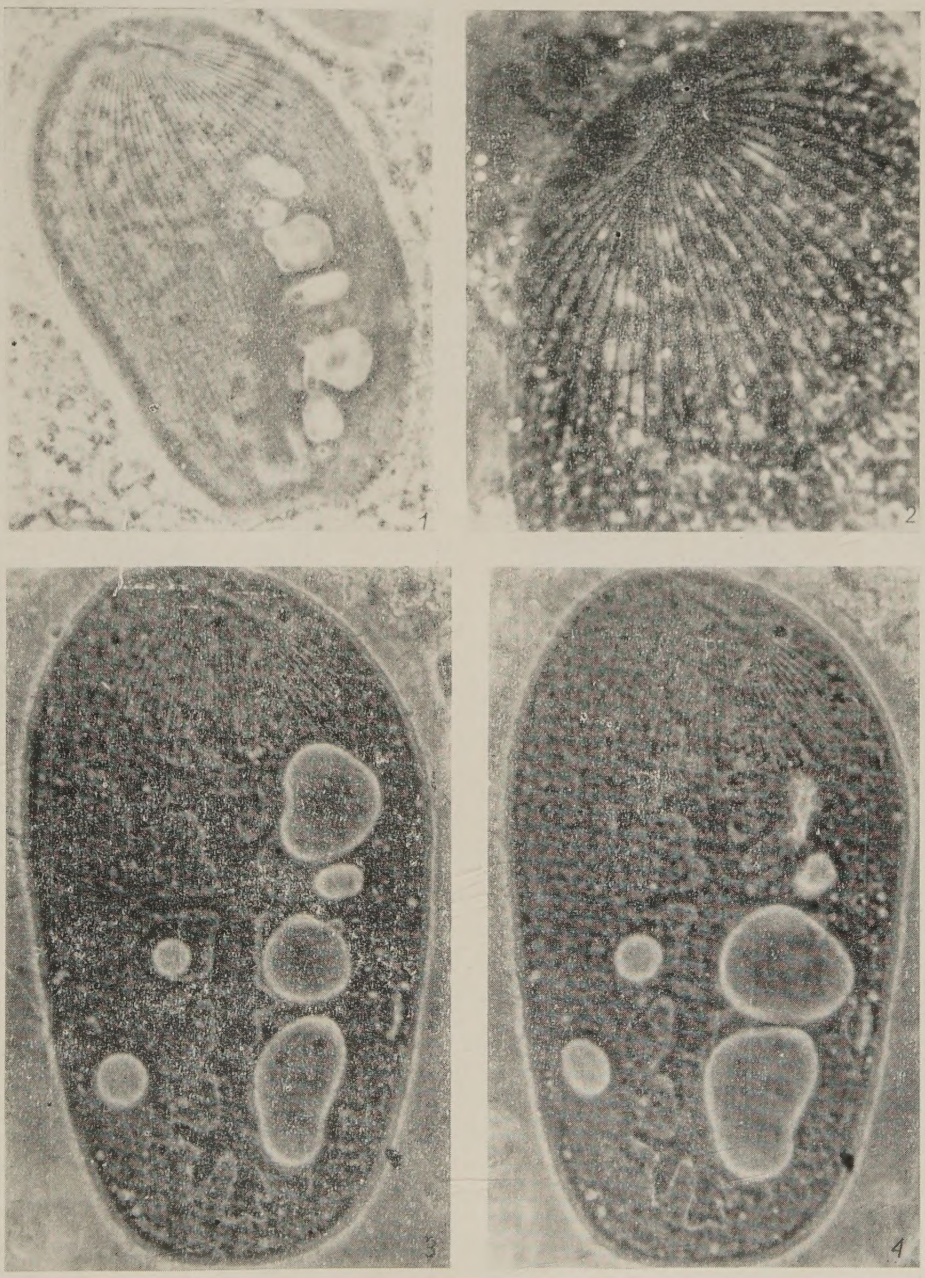
Phot. 1. General shape of *Helella rhizodrili* g.n.,sp.n.: cytoskeleton, macronucleus, contractile vacuoles. Phase contrast, infravital photograph.

Phot. 2. Cytoskeleton of *H. rhizodrili*. Phase contrast, infravital photograph.

Phot. 3 and 4. Functional changes of contractile vacuoles in *H. rhizodrili;* micronucleus well visible. Phase contrast, infravital photograph.

Phot. 5 and 6. Photographs of the same specimen of *H. rhizodrili*, taken in two different foci. I. H. preparation.

Phot. 7 and 8. The same in another specimen.



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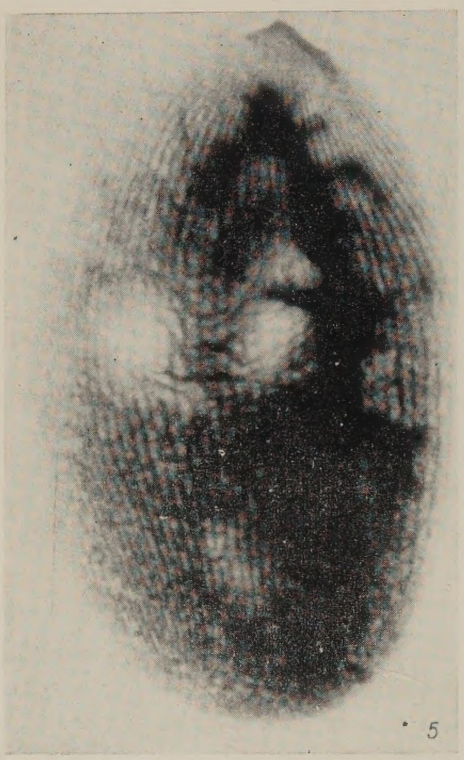
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